PETRICK, M., WEINGARTEN, P. (eds., 2004): The role of agriculture in Central and Eastern European rural development: Engine of change or social buffer?, *Studies on the Agricultural and Food Sector in Central and Eastern Europe*, *Vol. 25*, Halle (Saale), IAMO, pp. 162-183

ANALYSING VARIATION IN RUSSIAN DAIRY FARMS, 1990-2001

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ABSTRACT

Russian dairy enterprises underwent dramatic changes during 1990-2001. Not much is known about the position of these enterprises under the new conditions. This study examined a sample group of dairy enterprises in the Moscow region to try to identify similarities and divergences in historical background, performance, managerial and structural characteristics. A unique farm-level data set from 1990-2001 was used. Assessment of historical characteristics revealed that the currently most successful enterprises were those which in pre-reform years had already shown better economic performance. These farms also had, for the period studied, smaller percentages of reduced resources, no severe debt problems, and better overall management.

Keywords: performance, management, cluster analysis, dairy enterprises, Russia.

1 INTRODUCTION

In the past decade, Russian agriculture has undergone transformations that have had important impacts on the current settings in agriculture. This study only analyses agricultural enterprises, which in Russia co-exist with other agricultural producers such as family farms and private households. Agricultural enterprises, i.e. the former collective and state enterprises, lost part of their share in gross agricultural production but nevertheless kept their contribution to national employment (12% in 2000) and still operate on about 80% of total agricultural land in Russia. Having experienced forced restructuring and reorganisation in 1992-1995, the enterprises did not give way to private farming. Currently there are still more than 24,500 agricultural enterprises (data of 2001). In line with national statistics (see GOSKOMSTAT, 2002) on average, the agricultural enterprises declined in size, had lower economic performance, especially in the period 1996-1998 and experienced declining productivity. Agricultural enterprises

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in Russia still dominate among the commercial agricultural producers and thus determine the development of the sector.

A large body of literature focuses on the relation between the performance of Russian agricultural enterprise and characteristics such as their size, management, debts, restructuring and their relation with the state and urban service providers (EPSTEIN, 2001; PEDERSON *et al.*, 1998; SCHULZE *et al.*, 2001; ZEDDIES, 2000). The researchers stress the lack of effective management, which unarguably plays an important role in agricultural enterprises (KOESTER, 2003; SCHULZE *et al.*, 2001; VISSER, 2003; ZEDDIES, 2000). Previously the impact of initial pre-reform conditions was investigated in multi-country studies and appeared to be important (MACOURS and SWINNEN, 2000). DAVIDOVA *et al.* (2003) stressed the need to identify long-lasting phenomena determining the current performance of farms in Central and Eastern European countries. There has been no substantial study of historical conditions and their impact on farm performance for Russia.

It is a well-established fact that economic performance can differ considerably between farms[1], even under more or less similar production conditions. UZUN (2002) defined five groups of farms according to their solvency. The first group of financially sound farms (22% in 1999-2000) produces 51.5% of total marketable output. By comparison, the worst performing group includes 27% of farms, contributes 6.4% to total marketable output and has a level of outstanding debts that is four times larger than that of the first group. In general, this can be due to differences in management, which can be considered the fourth major factor in production, in addition to the traditional factors land, labour and capital (ROUGOOR *et al.*, 1998). There has been no study of variation in enterprise performance in relation to historical conditions and management in Russia, because of (a) the difficulty of quantifying managerial abilities, and (b) the absence of reporting such managerial characteristics as age, education, experience, etc., which are usually studied. In this study unobservable management was assessed through various performance-related characteristics over time.

Our approach to this research problem was, in a sample of dairy enterprises for empirical investigation, first to determine *which farm characteristics exhibited the most dramatic changes in 1990-2001*. The second objective was to find out whether the current dairy sector in the region was *homogeneous, or whether producers differed substantially*. Linking the historical and present farm characteristics provided the third objective: *to determine the impact of initial conditions* on current performance, structure and management. Addressing these objectives contributes to (a) understanding the development of dairy enterprises in the last decade, with the aim of (b) projecting future developments in regional

[1] The terms "agricultural enterprise" and "farm" are equivalent in this paper.

producers' structure and performance and (c) determining priorities in agricultural policies regarding different groups of producers.

To assess the variation among dairy enterprises, several characteristics were employed in cluster analysis for 2001 data (for example, EPSTEIN, 2001 use only financial indicators; UZUN, 2002). Historical characteristics for 1990 were assessed for each cluster. The pre-reform data gave insight into initial farm conditions; more recent data revealed the performance of Russian agricultural enterprises after the 1998 financial crisis.

The remainder of the paper is organised as follows: the next section is a literature review that helped build the research hypothesis on the relation between management, agricultural enterprise characteristics and performance; Section 3 describes the research method and data; Section 4 presents the results ordered by the three research objectives, while a discussion of conclusions in Section 5 finalises the paper.

2 CONCEPTUAL FRAMEWORK: FARM ENVIRONMENT, STRUCTURE, MANAGEMENT AND PERFORMANCE

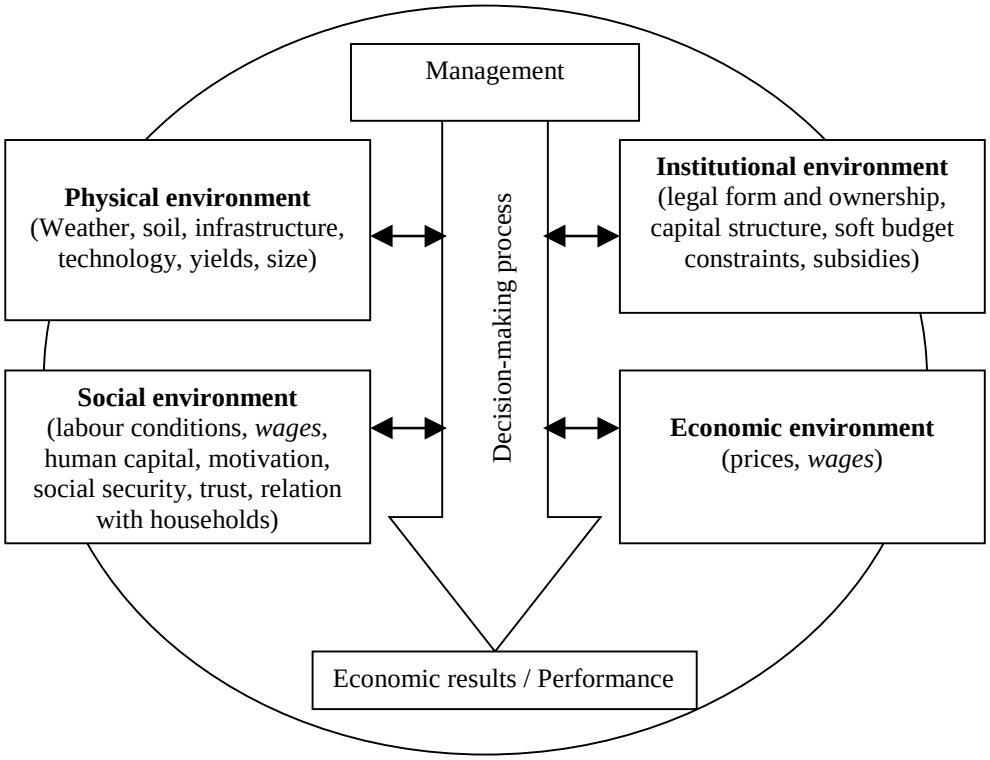
Various indicators of farm results are used in empirical analyses (see also ROUGOOR *et al.*, 1998): economic indicators (profitability, income), plain financial parameters (debt ratios) or technical performance (milk production and quality, disease rates). In empirical studies the farm result is often related to management[2]. Farm managers perform their tasks in a dynamic environment, in which BOEHLJE and EIDMAN (1984) distinguished four major dimensions: 1) the physical, such as seasonal weather conditions and their variability; 2) the economic, determining the relative as well as the absolute level of input and output prices; 3) the social, prescribing labour conditions and social networks; and 4) the institutional, prescribing (a) rules for the use of debt capital, (b) rules for payment of taxes, (c) legal rights and obligations, (d) relations between the state, institutions and producers.

Figure 1 presents the static state of a farm, its management and the four-dimensional environment. The current farm performance, management and environment are influenced by its historical farm structure, management and performance and affect future parameters. Figure 1 can be extended by incorporating these dynamic elements. The historical impact can be substantial for the current state of Russian enterprises as they have undergone restructuring in 1991-1994 and functioned under rapidly changing economic conditions in 1991-

[2] A one-sentence definition of management is difficult to formulate; in this study the concept of management is derived from (BOEHLJE and EIDMAN, 1984), who discusses the tasks and extent of farm management.

2001. Following the literature review, several elements of each farm environment are defined and their hypothetical impact is formulated. Often one element is associated with more than one environment, since there are many interlinkages among them.

Figure 1: Relation between farm performance and environment



Source: Authors' presentation.

Physical environment refers to the farm's structural characteristics, which are predetermined by natural and physical conditions (weather, soils, and infrastructure). The most intriguing and debatable farm structural characteristic in transition countries in the last decade has been farm size: "the big is beautiful" versus "the small is beautiful". VISSER (2003) elaborated on the Russian ideology of "big is beautiful" and concluded that larger agricultural enterprises in the Rostov region (famous for its agricultural activities) had a higher profitability, which is consistent with the findings of EPSTEIN (2001) for agricultural enterprises in the St.-Petersburg region. The large size of the enterprise may have a positive or negative effect on performance; a positive effect follows from economies of scale, whereas a negative effect follows from the increased complexity of management. SCHULZE *et al.* (2001) concluded that smaller agricultural enterprises in the Volgograd region have higher profitability. The definition of size is always relative and has to be expressed by the variables (hectares, workers, heads, sales, or assets) that are most relevant for the research question. Once several measures are available, which is unfortunately not the case for many studies with limited data, a clear justification of farm size variable should

be provided. The physical environment through the technology also defines such parameters as yields, intensity and specialisation, which also have an impact on farm performance. For example, on dairy farms a higher productivity of cows determines a higher technical efficiency (ONDERSTEIJN, 2002) and a higher gross margin per kg of milk (ROUGOOR *et al.*, 1997). Thus, farm structural characteristics (size, productivity, specialisation and intensity) reflect the physical dimension of the farm's environment.

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The physical environment, through technology, also defines such parameters as yields, intensity and specialisation, which also impact on farm performance. For example, on dairy farms a higher productivity of cows means greater technical efficiency (ONDERSTEIJN, 2002) and bigger gross margin per kg of milk (ROUGOOR *et al.*, 1997). Thus, farm structural characteristics (size, productivity, specialisation and intensity) reflect the physical dimension of its environment.

The institutional environment determines the capital structure and the way the financial obligations are dealt with. One frequently-studied institutional element of transition economies is "soft budget constraint" (SBC), *i.e.* routine loan forgiveness. According to SCHAFFER (1998), transition states often soften liquidity constraints by allowing enterprises to generate tax arrears. In contrast, SCHULZE *et al.* (2001) found no statistically significant relation between profitability and level of accounts payable. However, accounts payable are influenced by the discipline of customers, *i.e.* by the level of accounts receivable. High accounts receivable likely signal weak customer management or poor farm financial performance, preventing it from attracting reliable customers. In the earlier years 1993-1994 high debt had a negative impact on profitability and farm restructuring PEDERSON *et al.* (1998). Unprofitable farms often rely on state support in the form of subsidies. The relation between subsidies and performance on Russian

farms can be twofold. On the one hand, the theory of SBC predicts that poorly performing farms will have a high percentage of revenue from subsidies (OSBORNE and TRUEBLOOD, 2002). On the other, better managers are likely to be more efficient in getting subsidies, which requires the completion of applications; they may also have better relations with regional authorities (more than 70% of subsidies came from regional[3] budgets). A positive relation between subsidy and farm size could be expected, since (a) subsidies are coupled to inputs and outputs; and (b) lower per-unit transaction costs of acquiring subsidies on larger farms.

The legal form and type of ownership also belong to the *institutional environment*. Surveys in the Ukraine and Russia showed that about half of farm employees reported no real changes had taken place on the "reorganised" farms (LERMAN, 2001; LIEFERT and SWINNEN, 2002). SCHULZE *et al.* (2001) studied the variability of farm characteristics between groups of farms with different legal forms and concluded that in the Volgograd region limited liability and joint-stock companies had most successfully adapted to economic conditions. The new legal form was chosen by the reforming *kolkhozes* and *sovkhozes* rather randomly, with the exception of the poorest performing farms, restructured by splitting up (SVETLOV, 2000; VISSER, 2003). Therefore, the relation between ownership type (private, municipal, state), legal form (co-operative, joint stock, limited liability company, state enterprise) and performance is not unambiguous.

The social environment comprises characteristics of human capital, labour conditions and social security, factors also closely related to the *economic* and *institutional environment*. KOESTER (2003), VISSER (2003) and ZEDDIES (2000) concluded that a lack of human capital and employee motivation was a result of low wages. BEZLEPKINA and OUDE LANSINK (2003) found wages, corrected for wage arrears, a motivating factor in the improvement of the technical efficiency of Russian dairy farms. SEDIK *et al.* (1999) concluded that the diversion of resources from corporate farms to private household production negatively affected crop output on the corporate farms. That households can officially or unofficially use resources of agricultural enterprises to lower private production expenses (OVCHINTCEVA, 2000; PALLOT and NEFEDOVA, 2003), relies on an institutional environment that allows such relations and an economic environment that motivates them[4]. It can be assumed that higher wages improve farm work-

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[3] VISSER (2003) found that an enterprise managed by the same person for 39 years was highly successful, which signals that experience and possibly strong relations with community and regional administrations played an important role.

[4] "Unpaid workers were pilfering everything from milk to gasoline to tractor parts, and many of the ablest were migrating to the cities" (TAVERNISE, 2001). ZEDDIES (2000) assessed the

ers' economic incentives (see KOESTER, 2003). The level of wages is a managerial lever on the farm social (and economic) environment.

Economic environment refers to the level of input and output prices, interest rates and wages, and is closely related to the other dimensions. Declining terms of trade for agricultural producers is named as one major reason for the current unfavourable situation in Russian agriculture (STROKOV *et al.*, 2000; VARSHAVSKY, 2000). At the producer level, the deviation of enterprise-level price from the average price may signal superior quality of output, or special agreements with suppliers made possible by advanced management.

While the list of elements of the farm environment could be broadly extended depending on research interests, availability of enterprise-level data and the research questions in this paper have resulted in the following list of key farm environment characteristics: (a) size, farm location and dairy productivity (Physical); (b) legal form and ownership type, debts (Institutional); (c) milk price (Economic) and (d) wages (Social and Economic). Farm management could not be measured in this study directly. Good management can be observed in economic (high profitability) and financial (low debt ratios) performance, high dairy productivity, better quality of milk, higher prices, higher subsidies per unit of production, and a better social environment evidenced by higher wages and lower wage arrears. Farm history is related to time-variant farm characteristics such as performance, structure (size, specialisation, intensity) and management (productivity, wages).

3 MATERIALS AND METHODS

3.1 Analytical Procedure

Two dimensions were involved in the analysis of Russian farms: current farm characteristics in 2001 and their history back in 1990. To address the first objective, the performance, structure and management of dairy farms were analysed separately for the years 1990 and 2001. This contributed to understanding the population of dairy farms at present and a decade ago. A higher coefficient of variation (standard-deviation-to-mean ratio) indicated a greater variability in certain farm parameters between the two years. The effect of the farm environment can be cleared of stochastic elements (weather, price fluctuations) by analysing farm characteristics averaged over the last three years 1999-2001.

To address the first objective, the performance, structure and management of dairy farms were analysed for the years 1990 and 2001, separately. This analysis contributed to the understanding of the population of dairy farms at the present

level of theft on farms in the Moscow region at about 5-7% for grain, 15-20% of potatoes, 3-5% of milk.

time and a decade ago. A higher value of the coefficient of variation (standard-deviation-to-mean ratio) indicated a greater degree of variability of certain farm parameters in the two years.

Cluster analysis was used to address the second objective on the sources of variability between dairy farms under current conditions. Cluster analysis distinguishes groups of farms so that there is the greatest possible similarity within and difference between groups on the basis of selected farm characteristics that are derived from the four-dimensional farm environment in Section 2. The choice of the variables was motivated by a literature review and their number was kept to a minimum to ensure a sufficiently high number of degrees of freedom. Since more than ten size characteristics were available, the correlation coefficients have been analysed to determine the final size measures for cluster analysis (presented in Section 4). In this study, to ensure the stability of clusters, (a) both hierarchical and non-hierarchical methods were used (HAIR *et al.*, 1998); (b) cluster membership was tested for sensitivity to omitting the variables and to replacing the variables (e.g. arable land versus agricultural land; total workers vs. agricultural workers) and to omitting observations and (c) clustering was performed with data for 2001 and averages of the period 1999-2001. The final number of clusters used for further analysis was determined by the analysis of the agglomeration coefficient, the levels of significance comparing the differences between group means of cluster variables, the possibility to interpret the clusters focusing on variables with significant differences and the possibility to profile the clusters by using variables not included in the cluster solution. Depending on the outcome of the test of homogeneity of variances between groups, the Sidak test for equal variances or the Games-Howell test for not equal variances (Post Hoc tests, see SPSS, 2002) were used to test the significance of differences between paired groups.

To address the third objective, the characteristics of farms in 1990 and their development over the period 1990-2001 were assessed for each cluster. Spearman's rank correlation coefficient was computed for farms observed both in 1990 and 2001 to test whether the ranking of farms on farm characteristics are the same. If farms kept their ranking over the years, the coefficient was close to 1 and it implies that farms experienced similar changes or the situation in 1990 determines the outcome in 2001.

3.2 Dairy farms in the regional agriculture and clustering variables

Historically farms in the Moscow region specialised in livestock production, since the natural conditions of the region are especially unfavourable for crop farming. Crop production largely consists of forage crops (70% of arable land). The land area under marketable crops is rather limited: 20% under cereals, 3-4% under potatoes and about 2% under vegetables. The major products of agri-

cultural enterprises are milk, meat and eggs. A few farms strictly specialised in pig and poultry production, whereas the majority of farms had a differentiated output of milk, cattle meat and forage crops.

Farm data from large-scale specialised dairy farms in the Moscow region were obtained from data on Russian farms collected by the State Statistical Committee. The sample of 154 specialised dairy farms included only farms for which marketable milk production amounted to more than 2/3 of total revenue in 2001. Seven farms did not have balance sheet data and were omitted from the analysis. Of the remaining 147 farms, on average 80% of agricultural revenue came from milk and 10% from beef production. The amounts of other livestock production and arable farming were minor. Out of 147 farms, 90 farms existed in 1990 and 57 farms were newly established[5] sometime during 1991-2000. Preliminary analysis of selected farm characteristics identified a unique profile for 2 farms considered outliers[6].

Dairy producers in the region as well as in Russia have experienced a dramatic fall in profitability. Milk production was unprofitable in 1994-1998 and beef remained unprofitable up to 2001. Therefore, focusing on dairy producers in the region allowed investigating the weak and strong points of management in rather similar and economically more advanced conditions due to the overall better development of the Moscow region as compared to Russia (see KULESHOV, 2000).

4 RESULTS AND DISCUSSION

4.1 Dairy farms in 1990 and in 2001

Table 1 presents selected environment characteristics of dairy farms in 2001 and 1990. The panel was reduced to 88 farms to enable a direct comparison between the two years. Farms in 1990 in general can be characterised as mixed farms. Only 8 of them had more than 2/3 of revenue from milk. The average values from 88 farms in existence till 2001 were not greatly different from those which would have emerged if the specialised dairy farms in 1990 had been selected[7].

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[5] The overall number of farms in the region did not increase by more than 5% during restructuring in 1991-1994, nor by more than 3-4% during 1995-2001 (KULESHOV, 2000), implying there was only a small percentage of truly new farms. About 12% of all farms in 1990 could not be identified; probably more than 90 of them were such farms.

[6] Analysis of residuals in linear regression of farm characteristics (size, productivity) on profitability indicated these outliers. The three-cluster solution (see Section 4.2) remained consistent in omitting the outliers.

[7] The averages of farms in 1990 with more than 50% (110 observations), and with more than 60% (28 observations) of revenues earned from milk were computed. The difference in means remained within +/-10%.

This selection procedure enabled comparative analysis of the dairy farm populations.

As to the possible measures of farm characteristics named in Section 2, their choice was decided by a review of the literature, and their number kept low to ensure sufficient freedom of analysis. Net profit was selected as a measure of farm *performance* as it represents the final account of agricultural and non-agricultural activities as well as the level of received subsidies. This measure was not available in 1990, therefore Table 1 presents several alternatives.

The *physical environment* was given by agricultural land area, number of workers in agricultural activities, head of livestock, distance to Moscow and dairy cow productivity. Changes from 1990 to 2001 (see Table 1) and correlation coefficients between different size measures in 2001 (Table A.1 in Appendix) were assessed to select size measures. The above-mentioned number of *agricultural workers*, hectares of *agricultural land* and *livestock* were selected as measures of size because (a) land (<0.6) and labour (>0.9) had different correlation coefficients with other size measures and had substantially different percentage reductions in 1990-2001; (b) fixed assets were measured rather poorly (VOIGT and UVAROVSKY, 2001); (c) revenues are related to prices; (d) the number of cows and milk output are related to dairy productivity.

The price of milk was taken as indicator of farm marketing strategy and milk quality. Input prices (*e.g.* purchased feed, fertilisers, seeds, etc.) were not available from the farm data. Wages corrected for wage arrears were considered an indicator of both labour input costs and motivation, characteristics of the *economic* and *social environment*. The level of accounts payable, accounts receivable and the percentage of outstanding accounts payable, standing for the *institutional environment*, are not reported in Table 1 due to no data for 1990. Instead the percentages of farm legal form and private ownership are presented.

Table 1: Characteristics of dairy farms in 2001 and 1990 (n=88)

Environment	Farm characteristic	1990				2001				2001 in % to 1990
		mean	min	max	coefficient of variation	mean	min	max	coefficient of variation	
Performance	Profit before tax	10378	723	30678	0.50	4254	-3996	35313	1.75	-59
	Gross margin milk per kg, 10^3 RUB of 2001	0.14	0.02	0.44	0.52	0.12	-0.18	0.36	0.91	-14
	Profit before tax per hectare, 10^3 RUB of 2001	2.37	0.24	7.12	0.52	1.15	-1.31	7.94	1.66	-52
	costs to sales ratio	0.78	0.61	0.99	0.09	0.95	0.57	1.87	0.25	21
Physical	Total farm workers	552	268	913	0.28	209	36	811	0.61	-62
	incl. workers in agriculture, man	431	134	705	0.28	190	35	753	0.59	-56
	Agricultural land, ha	4673	1256	10209	0.34	3674	682	10899	0.47	-21
	incl. sown land, ha	3514	612	7182	0.36	2965	576	9570	0.49	-16
	Livestock, heads	3077	655	7313	0.34	1615	189	7973	0.72	-48
	incl. cows, heads	1488	130	3500	0.42	745	102	3200	0.70	-50
	Milk output, 1000 kg	54465	5188	144777	0.46	29689	2957	178240	0.95	-45
	Dairy productivity, 100 kg per head	39.7	25.8	77.5	0.20	40.1	18.4	77.7	0.30	1
Institutional	Percentage of kolkhozes, %	100				8				
	Percentage of joint stock companies, %	0				53				
	Percentage of cooperatives, %	0				27				
	Percentage of limited liability companies	0				2				
	Percentage of state companies, %	0				10				
	Percentage[1)] of farms with private ownership, %	0				84				
Social and economic	Wage annual, 10^3 RUB of 2001	33.7	6.4	57.8	0.19	31.8	8.3	67.1	0.41	-6
Economic	Milk price, RUB per kg	0.41	0.30	0.68	0.18	0.56	0.39	0.81	0.16	37

Notes: [1)] The remaining percentage of farms has municipal, federal or mixed ownership.
Source: Authors' presentation.

As seen from Table 1, dairy farms have changed a great deal during the last decade, becoming smaller in area, with fewer workers and livestock, and somewhat worse in economic performance. About 20% of them in 2001 had losses, whereas in 1990 all farms had positive net profits. The restructuring of 1991-1994 resulted in dairy farms in 5 different legal forms by 2001, the major part (50%) being joint-stock companies. Privatisation has resulted in the prevalence of private ownership (84%) over municipal, federal and mixed ownership types.

The coefficient of variation for all reported characteristics except milk price was smaller in 1990 than in 2001. This implies that earlier the farms were more homogeneous in size and performance, and less homogeneous in terms of specialisation. The criterion of 2/3 of milk revenues was checked for sensitivity by comparing the averages of 145 dairy farms in 2001 to the averages of 110 dairy farms (with >50% milk revenues) in 1990. The percentage change (last column of Table 1) remained within +/-5% for alternative calculation, confirming the conclusion of increasing variation in dairy farm size and performance.

Thus the dramatic changes in the environment of dairy farms in the region led to substantial changes in their structure and performance in 1990-2001.

4.2 Variation between dairy farms in 2001: Current sources

The more specialised dairy farms in 2001 demonstrated quite great variations in their structure and performance than in 1990, implying the existence of different groups of farms. The two- (17 and 128 farms), three- (88, 42 and 15 farms) and four-cluster solutions (68, 43, 9 and 25 farms) from the non-hierarchical K-means method were analysed. All three solutions formed a cluster with large and well-performing farms. The remaining clusters consisted of smaller farms with relatively similar size characteristics. Between the clusters of smaller farms for three- and four-cluster solutions, only the means of profitability and debt-structure were significantly different at the 5% level. For two-cluster solutions the difference between debts became less significant, while other cluster variables (except for wages) kept their significance at the 1% level. Going from three- to four-cluster solutions, the differences between clusters became less significant. This reasoning favours the three-cluster solution presented in Table 2. Table A.2 in Appendix 1 presents the analysis of agglomeration coefficients for hierarchical cluster analysis. The percentage increase in the coefficient of agglomeration for Ward's method occurs in the shift from three to two clusters, thereby also supporting the three-cluster solution[8].

With the exception of wages, the means of all clustering variables were significantly different (at the 1% level) between the clusters with the lowest (42 farms)

8 Other methods such as linkage between and within groups inconclusively indicated the existence of two to four groups.

and highest (15 farms) performance indicators, *i.e.* between marginal groups. The producers were divided into farms with performance and structure smaller than or close to average, located farther away from Moscow (cluster 1 and 2), and farms of larger size, higher productivity and performance indicators, and located closer to Moscow (cluster 3). Given these differences, the marginal clusters were named "average farms with low profitability and debt problems" and "large well-performing farms". The remaining cluster with the majority of farms, also large in terms of percentages of revenue, land, workers and livestock (see Table 3), consisted of rather "average farms". To stress the differences, the comparison was further continued between the marginal clusters (cluster 2 and 3). The three-cluster solution based on averages of 1999-2001 was very similar and thus is not reported, since the implication is that stochastic elements such as weather or prices did not affect the clustering of groups.

Table 2 Average characteristics of clustering variables (2001)

Environment/Variables		Average farms	Farms with poor performance and debt problems	Large well performing farms	Average values
		N=88	N=42	N=15	N=145
Performance	net profit, 10^3 RUB	2426	-289	18590	3311
Physical	agricultural workers, man	154[A]	163[A]	375	179
	agricultural land, ha	3248[A]	3456[A]	4744	3463
	livestock, heads	1303[A]	1215[A]	3507	1505
	distance to Moscow, km	88[A]	73[A,B]	53[B]	80
	milk per cow, 100 kg	40[A]	38[A]	58	41
Institutional	debt payables, 10^3 RUB	4293	13126[A]	11519[A]	7600
	debt receivables, 10^3 RUB	886[A]	1327[A]	5719	1423
	percentage outstanding debt payables, %	27[A]	37[A]	7	27
Social (and Economic)	annual wage corrected for wage arrears, 10^3 RUB	30[A]	27[A]	37[A]	30
Economic	milk price, RUB per kg	5.3[A]	5.6[A]	6.6	5.5

Notes: [A, B]: All differences in means are significantly different between the groups at the 5% level, except for when they have identical upper scripts. For example, the first and the second, the second and the last groups have no significant difference in distance to Moscow, but the first and the last group have.

Source: Authors' presentation.

Testing the difference in means of net profit per hectare, profit before tax per hectare, gross margin per kg of milk, cost-to-sale ratio (not reported) confirmed the significant difference for all groups at the 5% level. Significant variation in

debts between clusters of similar structure motivated the more detailed analysis of debt structure in Table 3. Significantly different between all groups, the ratio of total liabilities to total assets was less indicative than current-liabilities-to-current-assets ratio of the debt problem in farms with poor performance. However, they had the highest (a) number of farms under SBCs, (b) percentage of debts to the state (taxes and payments to social funds), and (c) level of overdue debts[9] (Table 2). Although all farms accumulated high debts, the nature of the debt problem varied: well-performing farms were involved in credit programmes, and had large turnovers with suppliers, whereas farms with low performance often failed to pay taxes, social security and wages.

Table 3 also presents other characteristics relevant to the clusters. Insignificant between all groups were: (a) the availability of processing facilities and the portion of processed milk (on average 5% on each seventh farm); (b) percentage of farms with private ownership and percentage of farms with a specific legal form (joint-stock and limited liabilities companies, co-operatives, collective and state companies); (c) degree of specialisation in milk production; and (d) subsidies in agricultural revenue. Co-operatives prevailed over other forms in the cluster with the most successful farms. However, this finding was not supported statistically.

Substantial variation in the intensity of farming confirmed that large and better-performing farms had higher intensity of production.

The share of subsidies in revenues was twice as high on the large and best-performing farms (but not statistically significant between groups). This weakly supported the *a priori* expectation that stronger managements were probably more efficient at getting subsidies. A high variability of subsidies calculated per worker and per unit of livestock between clusters with large and average size was a result of the differentiated subsidy programmes[10] (depending in some regions, for example, on livestock numbers, see BORKHUNOV and NAZARENKO, 2000). Most subsidies were received by better-performing farms, indicating that the state, having reduced overall direct support, was not overspending budget money on loss-making farms.

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[9] The level of overdue debts for such categories as short-term loans and long-term debts was not available from balance sheets, but from their appendices (see MINSELKHOZ, 2000).

[10] This however was not stated in legislative acts available to the authors (see for example ANONYMOUS, 1999, 2000).

Table 3: Other average characteristics of the clusters in 2001

		Average farms N=88	Farms with poor performance and debt problems N=42	Large well performing farms N=15	Average values N=145
Debts	Total debt to total asset ratio	0.14	0.25	0.14	0.17
	Current debt to current asset ratio	0.56	1.17	0.33	0.71
	Debts on borrowings, % to short-term debts	8[A]	6[A]	28	9
	Debt to the state, % to short-term debts	40[A]	46[A]	15	39
	Debt to workers per worker, RUB	1530[A]	3070	1520[A]	1980
	Debt payables to debt receivables ratio	10	39	4	18
SBC	Percentage of farms with debts exceeding profit before tax plus depreciation, %	23	64	0	32
Subsidy	Subsidy to agricultural revenue, %	2.4 [B,C]	1.6 [A,B]	2.8 [A,C]	2.2
	Subsidy per worker, RUB	2220[A]	1450[A]	4940	2270
	Subsidy per head of livestock, RUB	280[A]	190[A]	540	280
Intensity	Livestock per worker	8.4[A,B]	7.6[A]	9.3[B]	8.3
	Workers per hectare, man per 10 ha	5[A]	5[A]	9	6
Relative importance of cluster	In total revenue	45	20	35	100
	In employment	51	26	22	100
	In agricultural land use	57	29	14	100
	in total debts	34	50	16	100
	In total subsidies	44	15	41	100

Notes: [A, B, C]: All differences between the means are significantly different between the groups at the 5% level, except for when they have identical upper scripts.

Source: Authors' presentation.

Since many producers in the region delivered their milk to Moscow dairies (KULESHOV, 2000), the weak performance of farms could be partly due to locations distant from Moscow causing higher transport costs. There being no significant relation between on-farm processing and performance, these producers would be better advised to invest in improvement of milk quality, which should result in higher milk prices.

To summarise, a great variation between dairy producers in 2001 resulted in distinguishing three clusters which served the second research objective. The clustering depended upon size, location and such characteristics as profitability, level of wages, milk prices and subsidies, management of debts and dairy productivity. Availability of processing facilities, type of ownership and legal form, and the degree of dairy specialisation did not contribute to explaining the

variation between dairy farms in the region. Assessment of the relative importance of each cluster in regional dairy farming confirmed the difficulties for cluster 2 farms, which contributed the most to debts, the least to revenue, and used more labour and land resources than the best farms.

4.3 Variation between dairy farms in 2001: Historical sources

This section analyses the impact of farm characteristics in 1990 on the structure and performance of the same farms in 2001. Adding to the discussion of the development of farms between 1990 and 2001 (see Section 4.1 and footnote 5), 67 out of 98 dairy farms (with more than 50% of revenue from milk) continued their activities up to 2001 and the majority (48 farms) remained dairy specialised. The percentage of farms that continued to exist over the 11 years is highest (75%) in the group of well-performing farms[11]. A possible explanation for this is that better farms experienced less restructuring and splitting up their assets (see VISSER, 2003) and thus maintained their size and identity.

Table 4 presents the characteristics of the earlier- defined clusters for 1990. Only profit before tax (per hectare) and livestock numbers were significantly different between the marginal clusters. Dairy cow productivity, milk price, wages, gross margin per kg of milk and livestock per worker (neither presented) did not vary at the 5% level of significance. Variance in prices and wages was rather not expected in pre-reform conditions of strict state regulation. Spearman's rank correlation coefficient indicated a large difference in farm structure (except for agricultural land) and performance in 1990 and 2001. Larger farms with higher performance in 2001 (cluster 3) were better in the pre-reform period at generating profits before tax per hectare and slightly better in cost-to-sales ratio (although not significant at 5%). Farms in the third cluster were historically larger in number of workers and head of livestock, and reduced such resources as land, workers and livestock by lower percentages (13%, 26% and 6%, resp.) than other dairy farms (25%, 62% and 55%, resp.).

Since in pre-reform times the size did not vary significantly between the marginal clusters (land and workers, see Table 4) and the size measures had a smaller variability (see Table 1), it can be concluded that more advanced economic performance, rather than initial farm structure, complement the explanation of the variation between dairy farms in 2001. This conclusion addresses the third research objective.

[11] However, this percentage could be underestimated due to unidentified farms (see footnote 5).

Table 4: Historical characteristics (year 1990) of the clusters

Variables	Average farms	Average farms with poor performance and debt problems	Large well performing farms	Spearman's rank correlation coefficient for 1990 and 2001
	N=51	N=26	N=11	N=88
Profit before tax, 10^3 RUB of 2001	9546 [C]	9405 [C]	16533 [C, D]	0.235*
Profit before tax per ha, 10^3 RUB of 2001	2.28[D]	2.14[C]	3.35[C, D]	0.237*
Cost to sales ratio	0.78	0.80	0.75	0.100
Agricultural workers, man	405 [C]	450	504[C]	0.479*
Agricultural land, ha	4655	4554	5040	0.874*
Livestock, heads	2842[D]	3148[C]	3999[C, D]	0.317*
Milk per cow, 100 kg	39.8	39.0	41.4	0.323*
Annual wage, 10^3 RUB of 2001	33.3	34.1	34.8	0.124
Milk price, RUB of 2001 per kg	4.1	4.3	3.8	-0.123

Notes: [C, D]: All differences between the means are *not* significantly different between the groups at the 5% level, except for when they have identical upper scripts (interpretation is opposite in Tables 2 and 3). * Correlation coefficient is significant at the 5% level.

Source: Authors' presentation.

5 CONCLUSIONS AND OUTLOOK

By following the three research questions regarding the variation between dairy farms and their historical structure and performance, the following conclusions are possible:

- By 2001, as compared to 1990, dairy farms had become more specialised in their activities as well as more diverse in their structure and performance. The significant differences in performance between farms in 2001 was mainly due to individual farm management, reflecting changes in farm environment in such farm-specific characteristics as dairy productivity (livestock management), wages (social management), debt structure (debt management), etc.
- A more advanced economic performance already in 1990 implying stronger management rather than initial farm structure, helped explain the variation between dairy farms.
- Well-performing farms (cluster 3) evidenced better managerial characteristics observable in their performance.

The future development of the dairy sector in the region should rely on individual management, a decisive factor for farm development. The regional government should be aware that the largest share of subsidies (in 2001) was received by the best-performing farms. In contrast, average enterprises with low (negative) profits (cluster 1 and 2) should be a concern for policy-makers. The managers of these heavily indebted farms fear creditors, bankruptcy procedures and replacement of personnel consequences. The problem of farm debts has been recognised at the policy level: before bankruptcy procedure is applied, insolvent farms are given the opportunity to participate in a program of debt-restructuring supervised by federal and regional authorities. Starting in 2003 enterprises have been helped to review their financial performance on the basis of financial coefficients computed from balance sheets and income statements. Thus, there is a certain educational process taking place to inform farm managers about their financial performance. The state should continue training and education programmes for farm managers. The enactment of a new bankruptcy law has put the position of farm workers however in question. Since a group of farms with poor performance employs a quarter of all workers in the dairy sector, government assistance (social security support) should be guaranteed in case of farm liquidation.

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APPENDIX

Table A.1: Correlation coefficient among size measures in 2001

	total revenue	agricultural revenue	total workers	agricultural workers	agricultural land	arable land	livestock	cows	fixed assets	total costs in agriculture	kg of milk output
total revenue	1	1.00	0.91	0.89	*0.47*	*0.52*	0.93	0.91	*0.60*	0.98	0.98
agricultural revenue		1	0.92	0.90	*0.46*	*0.51*	0.93	0.92	*0.59*	0.98	0.98
total workers			1	0.98	*0.57*	*0.61*	0.94	0.93	*0.63*	0.92	0.91
agricultural workers				1	*0.58*	*0.62*	0.94	0.93	*0.62*	0.91	0.90
agricultural land					1	0.96	0.60	0.60	*0.41*	0.51	0.48
arable land						1	0.63	0.63	*0.44*	0.55	0.53
livestock							1	0.99	*0.58*	0.94	0.95
cows								1	*0.59*	0.92	0.94
fixed assets									1	0.63	*0.57*
total costs in agriculture										1	0.96
kg of milk produced											1

Source: Authors' calculations.

Table A.2: Analysis of agglomeration coefficient (AC) for hierarchical cluster (n=145)

Number of clusters	Ward's method		Between group linkage		Within group linkage		Median linkage	
	AC	%[1)]	AC	%[1)]	AC	%[1)]	AC	%[1)]
10	20.5	5.4	0.50	4.0	0.34	5.5	0.44	-17.2
9	21.6	7.5	0.52	8.3	0.36	1.7	0.36	42.6
8	23.2	8.4	0.56	25.0	0.36	7.2	0.52	5.6
7	25.2	8.6	0.71	2.5	0.39	2.7	0.54	44.8
6	27.4	9.7	0.72	21.5	0.40	11.5	0.79	1.9
5	30.0	10.8	0.88	15.3	0.44	10.5	0.80	13.4
4	33.3	13.8	1.01	34.4	0.49	12.3	0.91	-4.4
3	37.8	15.2	1.36	24.8	0.55	4.9	0.87	48.4
2	43.6	32.0	1.70	43.9	0.58	29.1	1.29	111.1
1	57.6	-	2.44		0.75		2.73	

Notes: [1)] The percentage change of agglomeration coefficient to the next level.
Source: Authors' calculations.